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THE MECHANICS OF INTRUSION OF THE BLACK HILLS
(S. D.) PRE-CAMBRIAN GRANITE

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The Pre-Cambrian rocks of the Black Hills consist of a great series of slates and schists, for the most part monotonously alike, striking in a northwest direction and having steep dips generally, except in the extreme southwest, to the east. Close study shows that the persistent eastward dips represent both schistosity and bedding, the two for the most part parallel; and that the series is compressed into a number of great folds which comprise innumerable minor isoclinal folds. A sufficient number of individual beds have been traced to locate the position and nature of the greater axes of folding, and to locate two important faults.

To the south great intrusions of granite break through the strata, and around the principal mass, forming Harney Peak, a notable schistosity is developed parallel with the granite contact, and superimposed upon the normal schistosity of the region.

Field relations indicate that this granite came into its present position in the main by physical distension of the invaded rock body, under great load, and that it thus modified to an important degree the normal process of regional compressive folding, forcing the schists into closely appressed recumbent folds, parallel with the advancing surface of the magma. The rocks were deformed; they yielded to the advance of the magma, and the schistosity produced by this movement and folding lent itself to the further injection of the granite by numberless parallel dikes and by lit-par-lit intrusion. The harder rocks, the quartzites, were distended and broken apart by the upward movement, and the magma flowed in between the blocks.

The relation of dikes to schist layers, the fact that lit-par-lit injection tends to neutralize chemical and physical differences between the magma and the invaded rock, the probable low temperature of the granite, and the fact that positive evidence of absorption or assimilation on a large scale is lacking, all support the belief that physical displacement and not assimilation was the primary process by which the forward movement of the magma was accomplished. The possibility that large blocks of roof in the areas of harder quartzite have been engulfed in the magma, and that this process was in these areas an important one, must remain an open question. In the main it is considered that the magma actually displaced the rocks either along great rifts or by pushing the yielding softer rocks before it into recumbent folds.

ON THE FOSSIL ALGAE OF THE PETROLEUM-YIELDING SHALES OF THE GREEN RIVER FORMATION OF COLORADO AND UTAH

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In the region extending from northwestern Colorado west into Utah and north into Wyoming, there are great areas of, generally, carbonaceous shales, which, in places, exceed 3000 feet in thickness. Scientific, as well as economic interest has been aroused in these shales, because they have recently been discovered to yield petroleum when subjected to destructive distillation in closed retorts. These shales are typically dark brown in color, very fine grained, hard, firm, tough and compact, except where weathered into thin, more or less curled and brittle laminae. Surfaces long exposed to the action of the weather bleach to whitish or yellowish gray. Some beds in the series of these shales already examined are so highly carbonaceous that they closely resemble compact lignite in appearance and burn readily when heated; other beds contain rather high percentages of finely divided mineral matter.

When freshly broken, the rock gives off a distinctly bituminous odor, but, so far as observed, it contains no free oily compounds, although nodules and particles of a substance resembling asphaltum, but insoluble in the usual solvents of that substance, are sometimes found; and, as already noted, petroleum is always found among the products of its distillation.

Careful study of the stratigraphic relationship of these shales by the U. S. Geological Survey, has shown them to belong to the Green River